



Centers for Disease Control and Prevention  
Epidemiology Program Office  
Case Studies in Applied Epidemiology  
No. 941-903

# Surveillance for *E. coli* O157:H7 - Information for Action

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## Student's Guide

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### Learning Objectives

After completing this case study, the participant should be able to:

- Discuss the process and criteria for placing a disease or condition on a state or national notifiable disease list;
- List the categories of information that should be included in a surveillance instrument;
- Summarize and interpret surveillance data;
- Recognize difficulties in balancing public health concerns with consumer and industry considerations in emerging issues.

This case study is based on surveillance and investigation activities of the Oregon Health Division between 1986 and 1995. The investigation described in the second half of the case study has been published in the following reference:

Keene WE, Hedberg K, Herriott DE, Hancock DD, et al. A prolonged outbreak of *Escherichia coli* O157:H7 infections caused by commercially distributed raw milk. *J Infect Dis* 1997;176:815-818.

This case study is largely derived from another study, "An Outbreak of *E. coli* O157:H7 Associated with Raw Milk," developed in 1994 by Julie R. Crom (Animal and Public Health Inspection Service US Department of Agriculture) and Richard C Dicker, MD, MSc (CDC). This case study was developed in 1998 by Richard C. Dicker. Substantial background information, reviews, and suggestions were provided to both case studies by:

William Keene, PhD, MPH; Fred Hoesly, MD, MPH; and Katrina Hedberg, MD, MPH (Oregon Health Division); Donald Herriott, DVM, MPH (USDA, APHIS, VS, Salem, OR); and Thomas Gomez, DVM (USDA, APHIS, VS, [CDC], Atlanta, GA)



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service



## PART I

**Dateline: 1986.** Infection with *Escherichia coli* O157:H7 was first recognized as a cause of human illness in 1982, when 26 persons in Oregon and 21 persons from Michigan developed bloody diarrhea after eating hamburgers contaminated with the organism. Both outbreaks were associated with restaurants of the same fast-food chain. In 1986 three patients in eastern Washington State were diagnosed with *E. coli* O157:H7 after being hospitalized with hemorrhagic colitis and subsequent thrombotic thrombocytopenic purpura.

An epidemiologic investigation linked these three cases and 37 others in the same community to a local restaurant that had served ground beef, the suspected vehicle of transmission. This outbreak was found to be part of a statewide increase in *E. coli* O157:H7 cases. Infections among nursing home residents and in patients with hemolytic uremic syndrome (HUS) were seen across the state, and an increase in sporadic cases of hemorrhagic colitis was noted at a Seattle health maintenance organization.

**Question 1:** Health departments use public health surveillance to keep track of diseases that affect the public's health. What is public health surveillance?

**Question 2:** What is the difference between *active* and *passive* surveillance systems? When might you use each?

Each State has a list of diseases of public health importance that must be reported to the health department when diagnosed by a health care provider. Given the information on the previous

page, public health officials in Washington and Oregon considered adding *E. coli* infection to their lists of notifiable diseases.

**Question 3:** What criteria would you use in deciding whether to add *E. coli* O157:H7 infection (or any other condition) to the reportable disease list in your State?

**Question 4:** What is the process for making a disease reportable? What are the alternatives?

**Question 5:** Assuming you would like to make *E. coli* O157:H7 infection a reportable disease in Oregon, what information must you specify in the regulation or statute?

**Question 6:** Assuming that you will add it to the reportable disease list in your state, what categories of information would you collect on an initial one-page disease report form?

## PART II

**Dateline: 1/1/93.** By 1993, *E. coli* O157:H7 (O157) has been recognized as an important foodborne pathogen that can cause serious illness. Numerous outbreaks across the country have been attributed to ground beef, roast beef, water, apple cider, and unpasteurized milk. Human infection occurs primarily through ingestion of food or water contaminated with bovine fecal material, but person-to-person transmission also occurs. The organism can survive for extended periods in water, meat stored at subfreezing temperatures, soil, and acidic environments, but can be destroyed by thorough cooking or pasteurization.

Patients infected with O157 typically present with severe abdominal cramps, bloody diarrhea, and low grade fever. Children and the elderly are at greatest risk for complications such as hemorrhagic colitis, hemolytic uremic syndrome, and death.

In 1990, Oregon added *E. coli* O157:H7 to its reportable disease list. Oregon requires reporting by health care providers, health care facilities, and laboratories. The Laboratories must also send isolates to the State Laboratory.

**Question 7:** What attributes characterize a good surveillance system?

You are an epidemiologist assigned to the \_\_\_\_\_ reviewing surveillance data on a regular basis. Oregon Health Division, and are responsible for \_\_\_\_\_

**Question 8:** What basic descriptive epidemiology would you like to see to characterize the occurrence of *E. coli* O157:H7 in Oregon?

**PART III**

Following are several tables of *E. coli* O157:H7 surveillance data collected in Oregon from

August 1990 through December 1992.

Table A: *E. coli* O157:H7 cases by year (ONSETYY) and month (ONSETMM) of onset, Oregon, 1990 - 1992

ONSETMM	ONSETYY			Total
	90	91	92	
1	-	2	1	3
2	-	2	2	4
3	-	2	7	9
4	-	5	5	10
5	-	1	12	13
6	-	10	25	35
7	2	26	41	69
8	14	28	17	59
9	19	15	19	53
10	12	13	7	32
11	5	6	9	20
12	7	1	11	19
Total	59	111	156	326

**Question 9:** Using a separate piece of graph paper, graph the data in Table A and interpret.

Table B: *E. coli* O157:H7 cases by year of onset and county, Oregon, 1990 - 1992

COUNTY	ONSETYY			Total
	90	91	92	
BAKER	0	1	0	1
BENTON	1	4	11	16
CLACKAMAS	7	11	21	39
COLUMBIA	1	2	5	8
COOS	0	0	1	1
DESCHUTES	2	0	0	2
DOUGLAS	2	4	4	10
GRANT	0	0	2	2
JACKSON	1	0	4	5
JEFFERSON	0	0	2	2
JOSEPHINE	0	0	1	1
LANE	6	9	16	31
LINCOLN	2	1	1	4
LINN	4	4	5	13
MALHEUR	3	0	1	4
MARION	9	8	10	27
MULTNOMAH	11	36	41	88
POLK	1	1	3	5
UMATILLA	1	0	3	4
WASCO-SHER	0	2	1	3
WASHINGTON	7	26	19	52
YAMHILL	1	2	5	8
Total	59	111	156	326

**Question 10:** Summarize the data in Table B and interpret.

Table C: *E. coli* O157:H7 cases by year of onset and 10-year age group, Oregon, 1990 - 1992

AGE10	ONSETYY			Total
	90	91	92	
0 TO 9	10	35	39	84
10 TO 19	10	11	31	52
20 TO 29	8	19	20	47
30 TO 39	7	14	10	31
40 TO 49	5	8	13	26
50 TO 59	6	8	14	28
60 TO 69	4	8	15	27
70 TO 79	6	5	8	19
80 TO 89	2	3	3	8
90 TO 99	0	0	3	3
Unknown	1	0	0	1
Total	59	111	156	326

Table D: *E. coli* O157:H7 cases by sex and 10-year age group, Oregon, 1990 - 1992

AGE10	SEX		Total
	F	M	
0 TO 9	42	42	84
10 TO 19	24	28	52
20 TO 29	22	25	47
30 TO 39	15	16	31
40 TO 49	17	9	26
50 TO 59	15	13	28
60 TO 69	11	16	27
70 TO 79	8	11	19
80 TO 89	2	6	8
90 TO 99	2	1	3
Unknown	1	0	1
Total	159	167	326

Table E: *E. coli* O157:H7 cases by year of onset and single year of age for those under age 11 years, Oregon, 1990 - 1992

AGE	ONSETYY			Total
	90	91	92	
0	1	0	2	3
1	3	6	6	15
2	2	6	6	14
3	3	5	4	12
4	0	6	6	12
5	1	3	3	7
6	0	3	4	7
7	0	2	5	7
8	0	0	2	2
9	0	4	1	5
10	1	0	7	8
Total	11	35	46	92

Table F: Population of all ages, all races, both sexes by age, Oregon, 1990  
(n=2,842,321)

<u>Age (yrs)</u>	<u>Population</u>	<u>% of N</u>
0-4	205,649	7.23
5-9	208,902	7.34
10-14	200,742	7.06
15-19	191,070	6.72
20-24	189,859	6.67
25-29	212,127	7.46
30-34	239,715	8.43
35-39	250,218	8.80
40-44	223,537	7.86
45-49	165,811	5.83
50-54	128,860	4.53
55-59	115,362	4.05
60-64	120,704	4.24
65-69	122,332	4.30
70-74	101,583	3.57
75-79	78,200	2.75
80-84	49,383	1.73
85+	38,267	1.34

Table G: Population of all ages, all races, both sexes by county, Oregon, 1990  
(n=2,842,321)

<u>County</u>	<u>Population</u>	<u>% of N</u>	<u>County</u>	<u>Population</u>	<u>% of N</u>
1 MULTNOMAH	583,887	20.54	19 CLATSOP	33,301	1.17
2 WASHINGTON	311,554	10.96	20 MALHEUR	26,038	0.91
3 LANE	282,912	9.95	21 UNION	23,598	0.83
4 CLACKAMAS	278,850	9.81	22 WASCO	21,683	0.76
5 MARION	228,483	8.03	23 TILLAMOOK	21,570	0.75
6 JACKSON	146,389	5.15	24 CURRY	19,327	0.67
7 DOUGLAS	94,649	3.32	25 HOOD RIVER	16,903	0.59
8 LINN	91,227	3.20	26 BAKER	15,317	0.53
9 DESCHUTES	74,958	2.63	27 CROOK	14,111	0.49
10 BENTON	70,811	2.49	28 JEFFERSON	13,676	0.48
11 YAMHILL	65,551	2.30	29 GRANT	7,853	0.27
12 JOSEPHINE	62,649	2.20	30 MORROW	7,625	0.26
13 COOS	60,273	2.12	31 LAKE	7,186	0.25
14 UMATILLA	59,249	2.08	32 HARNEY	7,060	0.24
15 KLAMATH	57,702	2.03	33 WALLOWA	6,911	0.24
16 POLK	49,541	1.74	34 SHERMAN	1,918	0.06
17 LINCOLN	38,889	1.36	35 GILLIAM	1,717	0.06
18 COLUMBIA	37,557	1.32	36 WHEELER	1,396	0.04

**Question 11:** Summarize these data by place.

**Question 12:** Summarize these data by person.

**Dateline: 4/19/93.** All *E. coli* O157:H7 case reports in Oregon are investigated by county health department nurse-epidemiologists. The investigation includes an interview about recognized sources for *E. coli* O157:H7 infection. Nurses at the Multnomah County

(which includes the city of Portland) health department noted that three recent cases had reported drinking raw milk within the nine days prior to disease onset. Suspecting a possible outbreak, they immediately notified the state epidemiologist.

**Question 13:** Calculate the expected number of cases in Multnomah County in April.  
(Hint: Should you use 1990 data?)

**Question 14:** What can account for an increase in the number of cases reported to a surveillance system?

## PART IV

Epidemiologists at the State Health Department reviewed all 1992 and 1993 *E. coli* O157:H7 case reports and identified three more of 13 sporadic cases (not related to any recognized outbreak) in persons who reported drinking Dairy A raw milk in the days before their onsets. These three persons did not appear to share any other common exposures. All lived in the

greater Portland area. Thus a total of 6 out of 13 sporadic cases reported drinking Dairy A brand raw milk, the only brand of raw milk sold in the Portland area. Additional (presumptive) cases were also reported among raw milk-drinking household members. The following table summarizes the 6 cases confirmed to date associated with Dairy A:

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<u>CITY</u>	<u>COUNTY</u>	<u>AGE</u>	<u>SEX</u>	<u>ONSET</u>
Portland	Multnomah	61	F	12/19/92
Sandy	Clackamas	3	M	03/21/93
Portland	Multnomah	43	M	04/03/93
Sherwood	Washington	9	M	04/07/93
Portland	Multnomah	34	M	04/11/93
Portland	Multnomah	38	F	04/14/93

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To determine whether the relatively high proportion of raw milk consumption was limited to the *E. coli* cases or simply reflected an increase in raw milk consumption overall,

investigators reviewed all cases of salmonellosis in the Portland area 1992 and 1993. Raw milk consumption was not reported for any of these cases.

**Question 15:** In addition to the state and local health departments, what other agencies should be involved, and what are their roles? Who are the stakeholders in this situation? What concerns are they likely to raise?

## PART V

Consultation with officials at the Food and Dairy Division of the Oregon Department of Agriculture (ODA) and with the USDA Animal and Plant Health Inspection Service (APHIS) Area Epidemiologist provided the following information:

The ODA Food and Dairy Division licenses raw milk dairies. There are five licensed cow dairies and one goat dairy in the state. In 1987, the FDA banned the distribution and sale of unpasteurized milk outside of the state in which it was produced. An FDA survey showed that intrastate raw milk sales were permitted in 27 states and raw milk was sold in at least 18 states in 1992. The 111 raw milk dairies in the U.S. constituted 0.06 percent of all dairies. It was estimated that raw milk sold to consumers constituted approximately 0.02 percent of the total milk production in the U.S.

Unpasteurized milk has been frequently implicated as a vehicle for many enteric infections, including campylobacteriosis and salmonellosis as well as O157 infection. Health food enthusiasts claim benefits result from drinking raw milk such as higher nutritive value and enhanced resistance to disease. While pasteurization does cause trivial decreases in thiamine, vitamin B<sub>12</sub>, and vitamin C contents, human nutrition studies have shown no advantage of raw milk over pasteurized milk. No evidence exists in support of claims for disease resistance.

Dairy A has 132 cattle and produces 350 gallons of milk per day that is distributed through 35 retail outlets, including major supermarkets and numerous health food stores. It is the only supplier of bovine raw milk in the Portland area. In the early 1980s Dairy A was the apparent source of a small outbreak of campylobacteriosis, but this finding was not made public at the time.

The ODA inspects all dairies in Oregon six times per year and collects bulk milk samples approximately every six weeks. Herds are also required to be tested for brucellosis and tuberculosis once each year by an accredited veterinarian. Samples from the bulk tanks are

tested for total bacterial count, *Salmonella*, milk fat percentage, added water, etc. In raw milk dairies, additional testing is done for fecal coliforms, but a maximum standard is not established and the numbers are strictly informational.

The mechanism by which raw milk becomes contaminated with O157 has not been documented; however fecal contamination associated with milking is presumed. Pathogen sources may include the farm environment, contaminated equipment used for milking, filtering, cooling, storing, and milk distribution, or infected farm workers. Preliminary evidence suggests that cattle transiently or sporadically shed O157 in their feces and that the excretion period ranges from hours to weeks. O157 is not known to cause clinical disease in cattle under natural conditions. Currently, not enough is known about the ecology of O157 in cattle to implement prudent, on-farm intervention measures to prevent future contamination.

**Dateline: 4/20/93.** Two epidemiologists including the Public Health Veterinarian from the Oregon Health Division and a sanitarian from the ODA Food and Dairy Division went to the dairy to inform the owner of the outbreak. While there, they collected swabs for culture from 30 manure piles near the milking area. Six raw milk samples were collected from the dairy and from several local distributors for testing and culture. Results from these preliminary tests will not be available for several days. Plans were made to do a complete herd test as soon as logistically possible.

Staff at the Oregon Health Division calculated the probability of finding by chance alone that at least six of the thirteen cases would have consumed raw milk, assuming that no more than 1% of the population in the area are raw milk drinkers. They reported the result in their epidemiology newsletter as follows: "The probability that at least six out of thirteen cases would be brand A drinkers by chance alone, given a 1% exposure prevalence, is 0.00000000162. (Or less than one in five-hundred million)."

**Question 16a:** List the lines of evidence that suggest that raw milk from Dairy A is the source of this *E. coli* O157:H7 outbreak.

**Question 16b:** After reviewing the lines of evidence you listed above, do you believe Dairy A's raw milk is the source (or at least a source) of *E. coli*?

**Question 16c:** What actions might you take next (e.g., issue warning about raw milk, pull raw milk off shelves, require pasteurization of raw milk, close Dairy A, do more investigation, wait for lab results, etc.)?

## PART VI

**Dateline: 4/21/93.** The Oregon Health Division went public. They issued a press release announcing that a cluster of six confirmed cases of *E. coli* O157:H7 in Portland area residents were linked to consumption of raw (unpasteurized) milk produced by Dairy A. At the same time, the Oregon Dept. of Agriculture announced a recall on Dairy A raw milk and arranged for the dairy's milk to be diverted temporarily to a nearby creamery for

pasteurization.

**Dateline: 4/26/93.** Results from the fecal and milk sample tests all came back negative for O157. The Oregon Department of Agriculture lifted the recall.

The investigation became a hot topic in the local press.

**Question 17:** What would be your "SOCO" (Single Overriding Communication Objective) to the media? What other "spin" might the local media put on this story?

## PART VII

**Dateline: 5/93.** The media portrayed the situation as the Government bullying a local businessman trying to make a living by selling a local product to informed local consumers. Letters to the Editor supported the dairy.

Meanwhile, a case was reported in a 73-year old man whose illness began on April 21. He had consumed raw milk from Dairy A.

**Dateline: 6/93.** Two sisters, one age 3 and the other age 9 months, were diagnosed with *E. coli* O157:H7 within a week of each other. The 3-year-old had consumed raw milk from Dairy A while visiting her grandmother on June 11 and 12. The 9-month-old had not consumed the milk, but was exposed to her sister. Samples of the implicated milk were tested at three separate labs but were found to be negative for O157.

After these new cases came to light, a meeting was convened with representatives of the Oregon Department of Agriculture, the Oregon Health Division, and the dairy's attorney. The parties agreed to test the milk every 2 weeks and perform 2 prevalence surveys of the herd. They also agreed that if the milk tested positive, a recall would be issued and pasteurization would be instituted. Animals testing positive for O157 would be removed from milk production.

**Dateline: 7/19/93.** A herd test was conducted on all 132 cattle on the premises. The testing found four animals in the milking herd positive for O157 (3% prevalence). The isolates from the positive animals matched the sub-typing on four of the previous human cases associated with the dairy.

**Dateline: 8/24/93.** Dairy A refused to allow a second herd test. No subsequent herd tests for O157 were permitted.

Oregon enacted an administrative rule requiring all unpasteurized milk to carry a warning label: *"This product has not been pasteurized... may contain disease-producing organisms"*.

**Dateline: Spring 1994.** A new cluster of O157 occurred involving three confirmed and four presumptive cases in three different families. As a result, ODA conducted a second herd test (by fecal swabs) at Dairy A. Two different subtypes isolated from the cases matched subtypes from at least two of the animals in the herd. The Oregon Health Division took the Dairy to court using a consumer protection statute that states "...cannot willfully spread an infectious disease." The court issued a restraining order preventing the dairy from selling raw milk.

**Question 18:** Consider the steps of a surveillance system (data collection, analysis, etc.) Which steps, if any, are traditionally the "weak links" in the system? How has the Oregon Health Division performed?

## PART VIII - CONCLUSION

The Dairy sued to vacate the restraining order, arguing that the subtyping results came back three weeks after the people became ill so there is no evidence of "ongoing public health threat." Further, the sale of raw milk was legal in Oregon and the health department had not come up with standards that the Dairy could meet to be able to market their product.

The restraining order was not lifted. Nevertheless, the dairy continued to sell raw milk surreptitiously until October 1995, when a Department of Agriculture "sting" operation

uncovered the sales. The dairy owner was fined and jailed for contempt of court. No Dairy-A-associated cases have been reported since June 1994.

**Dateline: 1995.** In response to this and another outbreak, legislation to outlaw the retail sale of raw milk in Oregon was introduced in 1995. It died in committee.

**Dateline: 1997.** The owner closed the dairy and sold the property to a developer for a substantial sum.

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### Appendix 1 - Solution to Binomial Problem

$$\sum_{x=i}^N \left( \frac{N!}{x! (N-x)!} \right) p^x (1-p)^{N-x}$$

where N = total number of observations (13)  
 x = i = all possible values from 0 to N  
 p = prevalence in population

To determine probability of at least 6 out of 13, add the probabilities for x ≥ 6.

Prob (x=0)	=	13!/0!13! × 0.01 <sup>0</sup> × 0.99 <sup>13</sup>	=	1 × 0.877521	=	0.878
Prob (x=1)	=	13!/1!12! × 0.01 <sup>1</sup> × 0.99 <sup>12</sup>	=	13 × 0.008863	=	0.115
Prob (x=2)	=	13!/2!11! × 0.01 <sup>2</sup> × 0.99 <sup>11</sup>	=	78 × 0.000089	=	0.00698
Prob (x=3)	=	13!/3!10! × 0.01 <sup>3</sup> × 0.99 <sup>10</sup>	=	286 × 9.0 × 10 <sup>-7</sup>	=	2.59 × 10 <sup>-4</sup>
Prob (x=4)	=	13!/4!9! × 0.01 <sup>4</sup> × 0.99 <sup>9</sup>	=	715 × 9.1 × 10 <sup>-9</sup>	=	6.53 × 10 <sup>-6</sup>
Prob (x=5)	=	13!/5!8! × 0.01 <sup>5</sup> × 0.99 <sup>8</sup>	=	1287 × 9.2 × 10 <sup>-11</sup>	=	1.19 × 10 <sup>-7</sup>
<b>Prob (x=6)</b>	=	<b>13!/6!7! × 0.01<sup>6</sup> × 0.99<sup>7</sup></b>	=	<b>1716 × 9.3 × 10<sup>-13</sup></b>	=	<b>1.60 × 10<sup>-9</sup></b>
<b>Prob (x=7)</b>	=	<b>13!/7!6! × 0.01<sup>7</sup> × 0.99<sup>6</sup></b>	=	<b>1716 × 9.4 × 10<sup>-15</sup></b>	=	<b>1.62 × 10<sup>-11</sup></b>
<b>Prob (x=8)</b>	=	<b>13!/8!5! × 0.01<sup>8</sup> × 0.99<sup>5</sup></b>	=	<b>1287 × 9.5 × 10<sup>-17</sup></b>	=	<b>1.22 × 10<sup>-13</sup></b>
<b>Prob (x=9)</b>	=	<b>13!/9!4! × 0.01<sup>9</sup> × 0.99<sup>4</sup></b>	=	<b>715 × 9.6 × 10<sup>-19</sup></b>	=	<b>6.87 × 10<sup>-16</sup></b>
<b>Prob (x=10)</b>	=	<b>13!/10!3! × 0.01<sup>10</sup> × 0.99<sup>3</sup></b>	=	<b>286 × 9.7 × 10<sup>-21</sup></b>	=	<b>2.78 × 10<sup>-18</sup></b>
<b>Prob (x=11)</b>	=	<b>13!/11!2! × 0.01<sup>11</sup> × 0.99<sup>2</sup></b>	=	<b>78 × 9.8 × 10<sup>-23</sup></b>	=	<b>7.64 × 10<sup>-21</sup></b>
<b>Prob (x=12)</b>	=	<b>13!/12!1! × 0.01<sup>12</sup> × 0.99<sup>1</sup></b>	=	<b>13 × 9.9 × 10<sup>-25</sup></b>	=	<b>1.29 × 10<sup>-23</sup></b>
<b>Prob (x=13)</b>	=	<b>13!/13!0! × 0.01<sup>13</sup> × 0.99<sup>0</sup></b>	=	<b>1 × 1.0 × 10<sup>-26</sup></b>	=	<b>1.00 × 10<sup>-26</sup></b>

The sum of probabilities for x = 6 through x = 13 = 1.62 × 10<sup>-9</sup>, or 0.00000000162.

Note that, with an expected value of 1 in 100, the probability of x=0 (0.878) plus the probability of x=1 (0.115) add up to 0.99. Therefore, any observed value of 2 or greater has a p-value less than 0.01.

## Appendix 2 - Case Definitions Used in Public Health Surveillance

### **Escherichia coli O157:H7 (2000 Case Definition)**

#### **Clinical description**

An infection of variable severity characterized by diarrhea (often bloody) and abdominal cramps. Illness may be complicated by hemolytic uremic syndrome (HUS) or thrombotic thrombocytopenic purpura (TTP); asymptomatic infections also may occur.

#### **Laboratory criteria for diagnosis**

- Isolation of *Escherichia coli* O157:H7 from a specimen, or
- Isolation of Shiga toxin-producing *E. coli* from a clinical specimen

#### **Case classification**

**Suspected:** A case of postdiarrheal HUS or TTP (see HUS case definition)

#### **Probable:**

- A case with isolation of *E. coli* O157 from a clinical specimen, pending confirmation of H7 or Shiga toxin or
- A clinically compatible case that is epidemiologically linked to a confirmed or probable case
- Identification of Shiga toxin in a specimen from a clinically compatible case, or
- Definitive evidence of an elevated antibody titer to a known EHEC serotype from a clinically compatible case

**Confirmed:** A case that meets the laboratory criteria for diagnosis.

#### **Comment**

Laboratory-confirmed isolates are reported via the Public Health Laboratory Information System (PHLIS), which is managed by the Foodborne and Diarrheal Diseases Branch, Division of Bacterial and Mycotic Diseases, National Center for Infectious Diseases, CDC. Both probable and confirmed cases are reported to the National Notifiable Diseases Surveillance System (NNDSS), but only confirmed cases are reported to PHLIS. Confirmation is based primarily on laboratory findings.

### **Hemolytic Uremic Syndrome, Postdiarrheal (Revised September 1996)**

#### **Clinical description**

Hemolytic uremic syndrome (HUS) is characterized

by the acute onset of microangiopathic hemolytic anemia, renal injury, and low platelet count.

Thrombotic thrombocytopenic purpura (TTP) also is characterized by these features but can include central nervous system (CNS) involvement and fever and may have a more gradual onset. Most cases of HUS (but few cases of TTP) occur after an acute gastrointestinal illness (usually diarrheal).

#### **Laboratory criteria for diagnosis**

The following are both present at some time during the illness:

- Anemia (acute onset) with microangiopathic changes (i.e., schistocytes, burr cells, or helmet cells) on peripheral blood smear and
- Renal injury (acute onset) evidenced by either hematuria, proteinuria, or elevated creatinine level (i.e., greater than or equal to 1.0 mg/dL in a child aged less than 13 years or greater than or equal to 1.5 mg/dL in a person aged greater than or equal to 13 years, or greater than or equal to 50% increase over baseline)

**Note:** A low platelet count can usually, but not always, be detected early in the illness, but it may then become normal or even high. If a platelet count obtained within 7 days after onset of the acute gastrointestinal illness is not less than 150,000/mm<sup>3</sup>, other diagnoses should be considered.

#### **Case Classification**

#### **Probable:**

- An acute illness diagnosed as HUS or TTP that meets the laboratory criteria in a patient who does not have a clear history of acute or bloody diarrhea in preceding 3 weeks or
- An acute illness diagnosed as HUS or TTP, that a) has onset within 3 weeks after onset of an acute or bloody diarrhea and b) meets the laboratory criteria except that microangiopathic changes are not confirmed

**Confirmed:** an acute illness diagnosed as HUS or TTP that both meets the laboratory criteria and began within 3 weeks after onset of an episode of acute or bloody diarrhea

#### **Comment**

Some investigators consider HUS and TTP to be part of a continuum of disease. Therefore, criteria for diagnosing TTP on the basis of CNS involvement and fever are not provided because cases diagnosed clinically as postdiarrheal TTP also should meet the criteria for HUS. These cases are reported as postdiarrheal HUS.